

What Do Trees Have To Do With Climate Change?



Grade Level: High School

Time & Setting: One class period (60-90 minutes); classroom and outdoor area with leafed-out, deciduous trees or shrubs

Note: In advance, the teacher may want to examine the trees in the area to identify potential trees (trees should be small, similar trunk size and growing in different areas of the property) for this activity

Materials and Equipment:

- Copies of KWL chart for each student
- computer or computer projector to watch introductory video
- activity pages (included at end of lesson plan)
- cloth tape measure
- ruler
- paper and pencils

Objectives:

- Students will be able to list 3 facts about the importance of forests in the climate change issue.
- Students will understand how a tree captures and stores carbon.
- Students will be able to give at least one thing they can do individually to help control climate change.

Instructional Procedures:

- Pass out KWL charts and have students fill in the first 2 sections of their KWL chart, then collect them.
- Teacher will do Introduction.
- Have students look over carbon cycle poster (link after introduction)
- Show 15 min. video on climate change and the importance of trees. (download and play instructions at end of lesson plan)
- Have students share their thoughts on the movie (things they thought were interesting, things they learned, things they might not have understood).
- Take the students outside for the hands on activity portion of this lesson. (Indoor classroom activities and additional background materials are also available in the Natural Inquirer FACELook edition.)
- Wrap up

Assessment:

After the students have done the lessons have them fill in the 3rd section of the KWL chart. You may use the rubric included to see how well they did.

Extensions & More Information:

Extension: After completing the FACTivity, have students reread “Thinking About Science” in the FACELook Natural Inquirer. In small groups or as a class, have students discuss their experience of working in groups while doing this FACTivity. Students should be reminded to be respectful and courteous in their discussion.

If you are a Project Learning Tree-trained educator, you may use Activity #28, Air Plants, as an alternative activity or an extension. From: Palmroth, S., Oren, R, McCarthy, H. R.

Estimate their school's greenhouse gas emissions and conceptualize ways to mitigate their school's climate impact (see “At School” section on Things YOU Can Do list in this packet).

This climate change lesson is from Natural Inquirer Monograph Series Number 1, January 2008, U.S. Forest Service. See www.naturalinquirer.usda.gov for more information, articles and resources.



Introduction

Climate change refers to changes in our long-term weather patterns and in the environment caused by increasing levels of carbon dioxide and other greenhouse gases released into the atmosphere. These gases come from burning wood, peat and fossil fuels (oil, coal, natural gas) for cars, cooking, heating, generating electricity for homes, commercial and industrial uses, and from natural events like forest fires and volcanic activity.

Greenhouse gases trap heat in the earth's atmosphere. Over time, more and more heat is retained, leading to an increase in the earth's average surface temperature - global warming. There is mounting evidence that our climate is changing rapidly and it is getting warmer.

Rapid climate change brings enormous risks and human costs. Rising sea levels, droughts, flooding and extreme weather are believed by many scientists to be the result of climate change. We can't predict all the effects, but it is clear we are vulnerable to climate change.

Conservation, increased energy efficiency and investment in renewable energy sources such as solar power, and managing our forests and woodlots as carbon storage are some short-term solutions to help reduce greenhouse gases and help moderate rapid climate change. But greater public awareness and action is needed to solve the problem.

FACTivity

Trees, Forests & Climate Change FACTivity

The questions you will answer with this activity are:

1. What is the estimated leaf area of two similar trees in your school yard?
2. How healthy do those trees appear to be?
3. What is one major tree part that affects climate change?

(Note: This activity must be done when leaves are on the trees.)

The method you will use to answer the questions is:

Before you begin, write one or two hypotheses (hi poth uh ses) stating what you would expect to find out in this inquiry. Each student may write his/her own, or you may develop the hypotheses as a class.

Note: A hypothesis is a written “if-then” statement that follows this form: “If X (a variable that you define) is related to Y (another variable that you define), then changing or observing a difference in X in this way (a change or difference that you define) will result in a change to or a difference in Y in this way (a change or difference that you define).”

Examples:

- If a tree has more leaves then it will capture more carbon than a tree with less leaves.
- If a tree is larger then it will contain more carbon than a smaller tree.
- If a tree high leaf surface area then it would capture more carbon than one with a small leaf surface area.

1. Select two small trees of similar trunk size. You must be able to reach into the tree’s canopy. If possible, select trees of the same species but growing in different areas of the schoolyard. Scientists measure tree trunks at the same height every time. This height, called “diameter at breast height” or d.b.h., is 1.37 meters or 4.5 feet from the ground. You should measure your trees at d.b.h. using a cloth measure. You will measure the circumference (not the diameter) of the tree’s trunk. The important thing is to find two small trees about the same size, and hopefully of the same species.

Divide the class into six groups. Three groups will work with one tree, the other three groups will work with the second tree.

2. Select a random sample of leaves from each of the trees. Have a group of four students (two students from one tree, two from the other) quickly determine the best way to make a random selection of leaves. You must be able to reach the leaves without using a ladder or other prop.

One group from each tree will select 20 leaves from their tree, using the selection process determined by the group of four students. If possible, do not pick the leaves but measure them while they are on the tree. Using a ruler, measure each leaf’s length and width.

FACTivity

Multiply the length by the width to calculate an estimate of the leaf's area. Measure at the widest point in the leaf. Do this for each leaf in your sample. Note that your measurement for each leaf's area will be too large, because leaves are not rectangular. However, if you measure the leaves on both trees in the same way, you can still compare the leaf area of the two trees. This is because the measurements will be equally too large. Accurately record the measurements for each tree, keeping the two trees' samples separate. Then, each group will calculate the average leaf area of their tree's leaves.

(Note: Do not climb into the tree or use a ladder or other prop to reach the leaves. Only measure the leaves you can reach while standing on the ground.)

3. Meanwhile, the second group from each tree will record the tree's site conditions. Use the included Observation Chart to observe and record the tree's site conditions.

4. Meanwhile, the third group for each tree will estimate the number of leaves on their tree. One idea is to count the number of leaves on one branch, then count or estimate the number of branches on the tree. By multiplying the two amounts, you will have an estimate of the number of leaves on the tree.

5. Inside the classroom, calculate the total leaf area of each tree (using table 2). Do this by multiplying the estimated number of leaves on the tree by the average leaf area. For each tree, complete the table below. If possible, reproduce this table on the white board so that the entire class can see it.

Hold a discussion to compare the two trees. Is one tree healthier than the other? How do you know?

As a class, make a list of at least three weaknesses of the inquiry process you just completed. Further discuss what you would do differently to improve the inquiry process. (Hint: For example, if you could have sampled leaves from the entire tree, your sample would better represent the entire tree.)

Wrap Up

Do a wrap up discussion with the students on what was learned concerning the importance of trees and climate change. If time you might want to go over the EPA list of what they themselves other than plant a tree, can do to help reduce carbon emissions and slow the climate change.



| Question | Answer and point value | Number of points |
|--|---|------------------|
| Does the tree have mulch around its base? | Yes=1 No=0 | |
| Is the soil around the tree eroded? | Yes=0 No=1 | |
| Is the tree shaded? | All day=0 More than half of the day=1 Less than half of the day=2 No=3 | |
| Are insects eating the leaves? | Many leaves affected=0 Some leaves affected=1 Few leaves affected=2 | |
| Is there damage to the tree's bark? | A lot of damage=0 Some damage=1 No=2 | |
| Are the leaves green and healthy? | Most=1 Most are not=0 | |
| Does the tree get adequate water? (Leave this question out if you do not know) | Yes=1 No=0 | |
| TOTAL POINTS | | |

| Tree 1 | Tree 2 |
|-----------------------------------|-----------------------------------|
| Species:_____ | Species:_____ |
| Circumference:_____ | Circumference:_____ |
| Estimated # leaves: _____ | Estimated # leaves:_____ |
| Estimated average leaf area:_____ | Estimated average leaf area:_____ |
| Total estimated leaf area:_____ | Total estimated leaf area:_____ |
| Site condition score:_____ | Site condition score:_____ |

KWL Chart

Student Name _____

Instructions are Teacher to read to students.

1. Write one or more things you **know** about climate change.
2. Write one or more things you **want to learn** about climate change.
3. After the movie and activity write one or more things you **have learned** about climate change.

| 1. What I <u>know</u> about climate change. | 2. What I <u>want to learn</u> about climate change. | 3. What I <u>have learned</u> about climate change. |
|---|--|---|
| 1. | 1. | 1. |
| 2. | 2. | 2. |
| 3. | 3. | 3. |
| 4. | 4. | 4. |
| 5. | 5. | 5. |
| 6. | 6. | 6. |

Rubric for KWL chart

| | 1 | 2 | 3 | 4 |
|--|---|--|---|---|
| Student demonstrates prior knowledge concerning climate change | Student knows little or nothing about climate change | Student shows a basic knowledge of 1 aspect of climate change | Student shows a knowledge of 2-3 aspects of climate change | Student shows knowledge of 4 or more aspects of climate change |
| Student developed thoughts/questions on what they would like to learn about climate change | Student has 1 thought or question concerning climate change | Student has 2 thoughts or questions concerning climate change | Student has 3 thoughts or questions concerning climate change | Student has 4 or more thoughts or questions concerning climate change |
| Student demonstrated that they learned something from the program on climate change | Student shows no new knowledge of climate change | Student shows new knowledge of climate change with at least one fact | Student shows new knowledge of climate change with 2-3 facts | Student shows much new knowledge of climate change with 4-5 facts |

What You Can Do

At Home

Turn off the lights and electronics

If you are leaving a room and no one else is using the lights or TV, turn them off. Turn off the computer and monitor when not in use. Unplug adapters such as cell phone chargers from the wall. They use a small amount of energy even when not charging.

Heat and cool smartly

When the heat or air conditioning is on, don't have open windows and doors. If the outside air is comfortable, turn off the air conditioning or heat and open up the windows.

Reduce, Reuse, and Recycle

If there is a recycling program in your community, recycle your newspapers, beverage containers, paper and other goods. Use products in containers that can be recycled and items that can be repaired or reused. In addition, support recycling markets by buying products made from recycled materials. Reducing, reusing, and recycling in your home helps conserve energy and reduces pollution and greenhouse gases.

Change 5 lights

Change a light, and you help change the world. Replace the conventional bulbs in your 5 most frequently used light fixtures with bulbs that have the ENERGY STAR and you will help the environment while saving money on energy bills. If every household in the U.S. took this one simple action we would prevent greenhouse gases equivalent to the emissions from nearly 10 million cars.

Be green in your yard

If you have grass to mow, use a push mower, which, unlike a gas or electric mower, consumes no fossil fuels and emits no greenhouse gases. It also gives you a great workout. If you do use a power mower, make sure it is a mulching mower to reduce grass clippings. Start a compost bin. Composting your food and yard waste reduces the amount of garbage that you send to landfills and reduces greenhouse gas emissions. It also can be used to add nutrients back to the soil.

Use water efficiently

Saving water around the home is simple. Turn the water off while shaving or brushing teeth. Do not use your toilet as a waste basket - water is wasted with each flush. And did you know a leaky toilet can waste 200 gallons of water per day? Repair all toilet and faucet leaks right away.

Spread the Word

Tell family and friends that energy efficiency is good for their homes and good for the environment because it lowers greenhouse gas emissions and air pollution. Tell 5 people and together we can help our homes help us all.

What You Can Do

On the Road

Buy smart

Before buying a new or used vehicle look for one that has lower emissions and great gas-mileage; such as a compact or hybrid car versus a large SUV. Check out EPA's Green Vehicle Guide (www.epa.gov/greenvehicles). This will not only put less carbon in the air but will save you money.

Drive smart

Many factors affect the fuel economy of your car. To improve fuel economy and reduce greenhouse gas emissions, go easy on the brakes and gas pedal, avoid hard accelerations, reduce time spent idling and unload unnecessary items in your trunk to reduce weight. If you have a removable roof rack and you are not using it, take it off to improve your fuel economy by as much as 5 percent. Use overdrive and cruise control on your car if you have those features.

Tune your ride

A well-maintained car is more fuel-efficient, produces fewer greenhouse gas emissions, is more reliable, and is safer! Keep your car well tuned. Also check and replace your vehicle's air filter regularly. For more details, including potential savings from these actions, visit the Fuel Economy Guide Web site.

Check your tires

Check your tire pressure regularly. Under-inflation increases tire wear, reduces your fuel economy by up to 3 percent and leads to higher greenhouse gas emissions and releases of air pollutants. If you don't know the correct tire pressure for your vehicle, you can find it listed on the door to the glove compartment or on the driver's-side door pillar. More details on the Fuel Economy Guide Web site.

Give your car a break

Use carpool or walk or bike whenever possible to avoid using your car. Leaving your car at home just two days a week will reduce greenhouse gas emissions by an average of 1,600 pounds per year. Whenever possible, combine activities and errands into one trip.

Use Renewable Fuels when possible

Both E85 and biodiesel are renewable fuels that can reduce greenhouse gas emissions from your vehicle. E85 is a fuel blend containing 85% ethanol that can be used in certain vehicles called Flex Fuel Vehicles (FFVs). FFVs can be fueled with E85 or with traditional gasoline.

At School (Remember many of the "at home" list can be used at school also.!)

High school students check your school's climate impact

High school students can investigate the link between everyday actions at their high school, greenhouse gas emissions and climate change. Using EPA's Climate CHange Emission Calculator Kit (Climate CHECK) (WinZip or Excel spreadsheet, 3.4 MB) students can learn about climate change, estimate their school's greenhouse gas emissions and conceptualize ways to mitigate their school's climate impact. Students gain detailed understandings of climate-change drivers, impacts, and science; produce an emission inventory and action plan; and can even submit the results of their emission inventory to their school district. You can also use Portfolio Manager to compare the energy use of your school with other schools nationwide, and earn the ENERGY STAR for your school if it qualifies as a top performer.

List from the Environmental Protection Agency (EPA) Web site:
<http://www.epa.gov/climatechange/wycd/index.html>

Correlation to National Standards

National Education Standards addressed by this lesson plan:

Science Education Standards

Science as inquiry

Abilities necessary to do scientific inquiry

Design and conduct a scientific investigation.

Develop descriptions, explanations, predictions, and models using evidence

Think critically and logically to make the relationships between evidence and explanations.

Life science

Populations and ecosystems

For ecosystems, the major source of energy is sunlight. Energy entering ecosystems as sunlight is transferred by producers into chemical energy through photosynthesis. That energy then passes from organism to organism in food webs.

Science in Personal and Social Perspectives

Science and technology in society

Science cannot answer all questions and technology cannot solve all human problems or meet all human needs.

History and nature of science

Science as a human endeavor

The work of science relies on basic human qualities, such as reasoning, insight, energy, skill, and creativity— as well as on scientific habits of mind, such as intellectual honesty, tolerance of ambiguity, skepticism, and openness to new ideas.

Nature of science

Scientists formulate and test their explanations using observation, experiments, and theoretical and mathematical models.

Mathematics

Compute fluently and make reasonable estimates

Develop and use strategies to estimate the results of rational-number computations and judge the reasonableness of the results.

Apply appropriate techniques, tools, and formulas to determine measurements

Analyze precision, accuracy, and approximate error in measurement situations.

Understand and use formulas for the area, surface area, and volume of geometric figures, including cones, spheres, and cylinders.

Apply informal concepts of successive approximation, upper and lower bounds, and limit in measurement situations.

Forest Service Educator Resources

Climate Change Resource Center

Developed by the Pacific Southwest and Pacific Northwest Research Stations, the Climate Change Resource Center is an excellent source of research and information for land managers on climate change. www.fs.fed.us/ccrc/

Forest Service Climate Change Home Page

This is the main Forest Service page for climate change. It provides excellent links to other FS programs and Web sites that offer additional information and materials. www.fs.fed.us/kidsclimatechange/climate.shtml

U.S. Forest Service - Conservation Education

Useful, informative Web site that provides a wide range of materials and resources for formal and nonformal educators. The mission of the CE program is to “connect people to the land by providing them with the tools they need to take informed actions related to sustaining natural and cultural resources.” www.na.fs.fed.us/spfo/ce/

Natural Inquirer Science Education Journal

The Natural Inquirer is a middle-school science education journal that brings FS research to life. There are numerous editions of NI, with many articles related to climate change research. The newest edition, “The World’s Forests”, is an excellent resource to help understand global forestry issues. NIs can be downloaded from the Web site, or limited copies of printed journals can be ordered from the program. On the Web site, search for climate change articles. www.naturalinquirer.usda.gov

Forest Service Pacific Northwest Research Station

Watch excellent, informative videos of Forest Service research scientist’s presentations on climate change. www.fs.fed.us/pnw/pep/climatechange/

Northern Research Station — Interactive Atlas of Climate Change

This NRS Web site allows you to examine current distributions and modelled future-climate habitats for 134 individual tree species or combined species by geographic areas. Changing forests mean changing habitat for the wildlife species that depend on them. The current and modelled distribution of 150 bird species is presented in the Climate Change Bird Atlas. www.nrs.fs.fed.us/atlas/

Western Wildland Environmental Threat Assessment Center

The mission of the Western Wildland Environmental Threat Assessment Center is to generate and integrate knowledge and information to provide credible prediction, early detection, and quantitative assessment of environmental threats in the Western United States. www.fs.fed.us/wwetac/

Eastern Forest Environmental Threat Assessment Center

The Eastern Forest Environmental Threat Assessment Center (EFETAC) is an interdisciplinary resource that is actively developing new technology and tools to anticipate and respond to emerging eastern forest threats. The site features excellent information and resources about climate change and other forest ‘threats’. <http://forestthreats.org/climate-change>

Partner Educator Resources

Climate Change Education Conference

The Forest Service has joined NOAA and Sally Ride Science in an Educator's Climate Change Conference to be held July 22-24, 2008 in Silver Springs, MD. The conference will also be webcast live and archived on the internet.

www.sallyridesience.com/for_educators/conferences/climate

Climate Literacy Brochure

Targeted audience K-12 teachers, but good for development of key messages on climate change for any age. Provides seven essential principles for teaching climate literacy. Climate literacy is an understanding of the climate's influence on you and society and your influence on climate. Correlated to National Science Education Standards. www.climate.noaa.gov/education/pdfs/climate_literacy_poster-final.pdf

Earth and Sky - Project Learning Tree

In cooperation with Forest Service and others, Climate and Weather Teacher's Center. Articles, activities on climate change and other environmental topics.

<http://www.earthsky.org/teachers/topic/climate-and-weather>

North American Association for Environmental Education

Environmental Education on the internet. EE-Link is: 5400 links organized in 300 categories, 11,000+ visitors per day. Browse or Search for resources for professional development, climate change, global warming, lesson plans, endangered species, national and international events, and more. <http://eelink.net/pages/Climate+Change>

Living in a Global Forest

This curriculum has students compare the ecological footprint of a home constructed in 1950 with one constructed in 2000. Students will learn where our wood comes from now and will analyze global efforts to manage the world's forests.

<http://www.foresthistory.org/Education/Curriculum/>

Carbon Cycle Poster from Forest Foundation

www.calforestfoundation.org/pdf/carbon-poster.pdf

National Oceanic and Atmospheric Administration - Web site and DVDs

NOAA website is rich in resources for teaching climate change. This shows the contents of a DVD disk set available from NOAA for teaching climate change topics.

www.ipyn.noaa.gov

Environmental Protection Agency - Climate Change Information

EPA's main climate change information page, this site is loaded with easy to understand information on the science behind global climate change. Includes an award-winning kid's site, carbon and water footprint calculator, and "what you can do."

www.epa.gov/climatechange/

Environmental Protection Agency – Earth Day 2008 Climate Change Education resources for all ages. www.epa.gov/region8/ee/2008epacket.html

Department of Energy - Alternative Energy Sources Web site for Kids

Department of Energy's cool "portal" site that leads kids to great on-line games and age appropriate alternative energy sources such as wind, solar, geothermal, alternative fuels and more. www.eere.energy.gov/kids/

Instructions for Video Download & Play

Instructions for downloading and playing a Web Video in a “family meeting” setting where employees are congregated in a large conference room.

Step 1: Assemble Necessary Audio/Visual Equipment

- Laptop or other computer in conference room.
- Projector (InFocus or equivalent) to project computer’s display on the conference room’s screen.
- Projection screen in classroom.
- Powered Speakers to amplify audio from the video so everyone in the room is able to hear.
NOTE: your laptop or computer speakers alone will not get the job done.* (see alternative option below).
- Video File; see below for detailed instructions.

* An alternative to powered speakers is to line out the audio from the computer into an amplifier. Generally, this would require using a cable with a minijack stereo connector on one end (computer connection) and stereo RCA connectors on the other end (amplifier connection). However, based on your specific stereo equipment, the cable requirement may differ.

Step 2: Download Video File

- Click on - <http://fsweb.wo.fs.fed.us/video/climate/> and scroll down on the Web page to the “Downloadable Version” section. If you have problems resolving this Web address try - <http://199.131.12.22/video/climate> ** (see alternative option below)
- ‘Right-click’ with your mouse over the “Windows Media” hyperlink and select “Save Target As...”
- A “Save As” window will open. At the top very top of this window there is a drop-down menu called “Save in:” Click the ‘down arrow’ and select “Desktop” near the top of all the other choices. Then click “Save”
- Allow the video file to download to your desktop. It will take a few minutes due to the size of the video.

** The video file is also located on a FTP server; here -

<ftp://ftp2.fs.fed.us/incoming/dwalbert/video/climate/>

Step 3: Download Lesson Plan & Supporting Materials

- Click on - <ftp://ftp2.fs.fed.us/incoming/wo/sfrost>
- ‘Right-click’ on “jc-lesson-plan” folder and select “copy”.
- Navigate to the where you want to store the files on your hard drive. Select ‘paste’ from the file menu.
- Alternatively, you can simply click on the “jc-lesson-plan” folder and drag it onto your desktop. The entire folder will copy onto your hard drive.

Step 4: Play Video

On the computer’s desktop, you should see a file named “climate-change-educator.wmv” – ‘double-click’ this file with your mouse and Windows Media Player should start to play the video.

Troubleshooting Support

Make sure you complete a trial run with the video before your lesson! If you need assistance with this video and getting things to play, please contact Sandy Frost at (202) 205-3761 or sfrost@fs.fed.us.